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SUBJECT: DAILY EXPOSURE EXPECTED FROM MIXING/LOADING VERSUS FROM APPLYING/INCORPORATING

Documented below is the justification for use of a ratio of 98:2 for daily exposure expected from mixing/loading pesticides under open-pour loading to that from applying/incorporating the resultant mixture under an enclosed cab. This justification was peer-reviewed when it was still part of the earlier version of the cycloate mitigation document (Dong, 1996).

In some worker exposure monitoring studies, no efforts were made to separate exposure monitoring of mixer/loaders from driver/applicators. However, such a separation is critical in terms of setting the appropriate measures for exposure mitigation. Based on experience by the Worker Health and Safety Branch (WH&S) with many agricultural chemicals, as summarized in the reviews by Rutz and Krieger (1992) and by Maddy *et al*. (1984), it is expected that in many cases mixing/loading pesticides under open-pour loading would account for more than 98% of both the dermal and the inhalation exposures involved provided that application and incorporation were made under an enclosed cab.

In the review by Maddy *et al*. (1984), the (available) median dermal exposure was calculated to be 14.8 mg/day for ground applicators who beforehand also mixed and loaded pesticides under a *closed* system during the same 7-hour work day. The median dermal exposure was calculated to be 0.5 mg/h (or 3.5 mg per 7 h) for handlers who worked as ground *applicators* only. These exposure calculations were based on a total of 102 different applications made to agricultural fields in California. The pesticides included in the review were parathion, mevinphos, TOK (nitrofen), DEF/Folex, and chlorobenzilate. There is the general consensus within and outside of WH&S that while a worker would spend 15 minutes to 1

hour in mixing/loading liquid mixture sufficient for one ground application, this same individual would spend between 1 and 6 hours in spraying the resultant mixture. This work time difference, together with the historical exposure data compiled in the 1984 review, forms the basis for supporting the above assumption, that mixing/loading under *open-pour* loading would account for more than 98% of the daily exposure to be received by a worker who (later on but during the same day) would also apply and incorporate the resultant mixture while sitting inside an *enclosed* cab. (The 98:2 ratio was determined from the following daily as well as one-hour exposure, M/L_g, calculated for mixing/loading by ground mixer/loader/ applicators: M/L_g = 14.8 mg (from total daily) – 0.5 mg/h x 6 h (from application alone) = 11.8 mg under a closed system, which is equivalent to 236 mg under open-pour loading (i.e., after adjustment for the default 95% protection from using a closed system (Thongsinthusak *et al*., 1993a; Thongsinthusak and Ross, 1994)).

The observations made later by Rutz and Krieger (1992), who reviewed subsequent worker exposure studies conducted by WH&S, also supported the use of the 98:2 ratio. In that later review, the (available) geometric mean exposure was estimated to be approximately 5 μg/h for both ground boom and airblast applicators sitting inside an *enclosed* cab. The data compiled in that 1992 review also showed that the geometric mean exposure was approximately 2,200 μg/h for workers preparing liquid mixture under *open-pour* loading for both *ground* and *aerial* applications. There were more individual monitoring observations (periods) included in the review for ground application than for aerial application, by about 4 or 3 to 1. On an hourly basis the exposure of mixer/loaders preparing liquid mixture for aerial application is expected to be much higher than that for ground application primarily because of the volume and loading frequency involved. This expectation is consistent with the observation made in Thongsinthusak *et al*. (1993b) that the hourly exposure of mixer/loaders to chlorothalonil for aerial application was about 2.5 times that for ground application. These last two observations suggest that for mixer/loaders preparing liquid mixture under open-pour loading for *ground* application *only*, the above geometric mean exposure calculated from the 1992 review data should be reduced to somewhere between 1,500 and 2,000 μg/h (to discount the excessive amount attributable to mixing/loading for aerial application). Since ground mixer/loader/ applicators would spend around 1 h in mixing/loading and 6 h in application, this 1992 review demonstrated again that mixing/loading under open-pour loading would account for more than 98% of the daily exposure for this work group.

Exposure data extracted from the Pesticide Handlers Exposure Database (PHED, 1995) indicated that the ratio was much higher than 98:2, whether the geometric (yielding a ratio of 627:3.6) or the arithmetic (yielding a ratio of 1,648:8) means were used as the average total body dermal exposure rates (*per pound*, not per hour, of active ingredient mixed or applied) for open-pour mixing/loading and for ground application under an enclosed cab. The exposure data included in the PHED subsets for this ratio calculation were limited to those of grade A or B quality for the uncovered or the covered areas, and for (daily) use of ≥ 10 lb of emulsifiable herbicide concentrates by workers wearing gloves, long pants, and a long-sleeved shirt.

References

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